

Progress on optimization of calorimeter weights for jet finding

HCAL depths in ORCA4:

HB0 - first scintillator layer

HB1 - main segment

HB2 - last scintillator layer (inside the solenoid)

HB3 - outer calorimeter

HE0 - first scintillator layer

HE1 - main segment

I found that reweighting of HB2 and HB3 can improve the jet resolution by no more than 0.5%. So I use further equal weights for HB1, HB2, HB3.

Using HLT samples (i.e. QCD 2->2 events) at low luminosity from ORCA4_2_0 database to calculate jet resolution.

Generator and off-line jets are found with the iterative cone algorithm in ORCA (cone of 0.5).

An off-line jet is matched to a generator one if closer than 0.2 in (η, ϕ) . Jet energies reconstructed in ECAL and different HCAL layers are saved for further reweighting.

Trying to optimize ECAL/HCAL0/HCAL1 weights for best jet energy resolution at several different values of jet transverse energy and pseudorapidity.

To properly calculate energy resolution for particular values of transverse energy and pseudorapidity the calorimeter is recalibrated for each set of weights by making a linear fit

$$ET = a(weights) + b(weights)ET_{gen}$$

in the region of a given $ET_{gen} \pm 20\%$.

After applying these calibration corrections energy resolution is calculated as $rms\left(\frac{ET_{rec}}{ET_{gen}}\right)$ over the region of $ET_{gen} \pm 10\%$.

Calibration leaves only two of the three weights independent, so I keep the main HCAL segment weight equal to unity and vary the weights of ECAL and HCAL0.

Table 1: Calorimeter weights(ECAL,HCAL0,HCAL1) giving best jet energy resolution and corresponding changes of resolution

η range \ Et	30 GeV	50 GeV	80 GeV	120 GeV
0.0-0.3	1.2, 1.0, 1 .222-> .220	1.3, 1.5, 1 .182 -> .175	1.3, 1.4, 1 .147-> .142	1.2, 1.7, 1 .124-> .121
0.6-0.9	1.3, 1.0, 1 .235-> .229	1.3, 1.5, 1 .164 -> .156	1.3, 1.8, 1 .137-> .130	1.2, 1.7, 1 .122-> .117
1.8-2.1	1.5, 1.7, 1 .212-> .199	1.5, 1.3, 1 .159 -> .146	1.3, 1.6, 1 .132-> .127	1.4, 1.6, 1 .119-> .110
2.4-2.7	1.3, 1.7, 1 .156-> .151	1.1, 1.4, 1 .138 -> .136	1.2, 0.6, 1 .142-> .138	1.2, 1.3, 1 .123 -> .119

Note: strange inconsistent results for energy resolution in 2.4-2.7 η -bin

Statistic error of resolution calculations is 5%. However, the ratio of resolutions with optimal and unity weights at each point was found to have a smaller statistical error of 1-2% (because resolutions derived from a common data sample are correlated).

Conclusions:

Jet energy resolution can be slightly improved (4-5%) by increasing ECAL response by 1.3 ± 0.1 and first HCAL layer response by 1.5 ± 0.3 with respect to the main HCAL segment.

Better accuracy of calculations can be achieved if no (E_t, η) dependency of calorimeter weights is assumed.